Fall 2020

ME 311-103: Thermodynamics I

Abdul Ali

ME 311 – Thermodynamics I

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Name of Instructor: Dr. Abul F. Ali

Text book: Thermodynamics – An Engineering Approach, 9th edition,
by Cengel and Boles, McGraw-Hill publisher

Course Description

This is course deals with the introduction to the concept of energy and its transformation to work and heat. Property data and the laws of thermodynamics are applied to open and steady-flow systems to perform energy balance of various engineering devices. Concepts of reversibility, thermal efficiency are introduced, Carnot heat engine and refrigerator are discussed. Concept of entropy is developed and applied to perform entropy balance. 2nd law efficiency and exergy balance are applied to analyze closed system and control volume.

Course Objectives

After successful completion of the course, the students should be able to:

1. Understand SI measurement units used in engineering.
2. Understand system and control volume approach in thermodynamics.
3. Develop a concept of thermodynamic properties, states, processes, and cycle.
4. Identify forms of energy, mechanical energy and their applications.
5. Recognize work and heat.
6. Apply 1st law of thermodynamics, thermal efficiency.
7. Be familiar with property tables for fluids.
8. Understand ideal gas equation, compressibility and other equations of states.
9. Perform energy balance of closed system.
10. Perform energy balance of steady-flow system.
11. Apply energy balance equations to various engineering devices.
12. Understand the 2nd law of thermodynamics, reversible and irreversible processes, Carnot heat engine & refrigerator.
13. Develop a concept of entropy, isentropic processes.
14. Apply T-ds relationships in solving problems related to ideal gases for various engineering devices.
15. Understand isentropic efficiency related heat engines and refrigerators.
16. Perform entropy balance of thermodynamic systems.
17. Understand exergy transfer and destruction.
18. Apply exergy balance for closed and steady-flow systems.

Course Syllabus

Week	Topic	Chapter	Exercise Problems & HW
1,2	Introduction, Dimensions and Units, Unit Conversion, System and Control Volume, Properties, States, Processes and Cycles, Temperature, Pressure.	1	Assigned during lectures.
2,3	Forms of Energy, Mechanical Energy, Energy Transfer by Work, 1st Law of Thermodynamics, Energy Conversion Efficiencies.	2	Assigned during lectures.
4	Pure Substance, Phase Change, Property Diagram, Thermodynamic Tables.	3	Assigned during lectures.
5	Ideal Gas Equation of State, Compressibility Factor, Other Equation of State.	3	Assigned during lectures.
Exam #1 covering chapters 1, 2, and 3			
6,7	Moving Boundary of Work, Energy Balance of Closed System, Specific Heats, Internal Energy, Enthalpy, Specific Heat for Ideal Gases, Specific Heat of Solids and Liquids.	3, 4	Assigned during lectures.
8	Conservation of Mass, Flow Work, Energy Balance of Steady Flow Systems.	5	Assigned during lectures.
9	Steady Flow Engineering Devices: Nozzles & Diffusers, Turbines & Compressors, Throttle Valves, Mixing Chambers, Heat Exchangers.	5	Assigned during lectures.
10	Introduction to 2nd Law, Thermal Reservoir, Heat Engines, Refrigerators, Heat Pumps, Perpetual Machines, Reversible & Irreversible Processes, Carnot Cycle, Carnot Principle, Thermodynamic Temperature Scale.	6	Assigned during lectures.
11	Carnot Heat Engine, Carnot Refrigerator and Heat Pump.	6	Assigned during lectures.
Exam #2 covering chapters 4, 5, and 6			

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Course Syllabus *Continued* …….

Week	Topic	Chapter	Problems
12	Entropy, Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams involving Entropy.	7	Assigned during lectures.
13	T-ds Relationship, Entropy Changes of Liquids and Solids. Entropy Changes of Ideal Gases, Reversible Steady Flow Work, Compressor Work, Isentropic Efficiencies of Steady Flow Devices, Entropy Balance	7	Assigned during lectures.
14	Exergy, Reversible Work, Irreversibility, 2nd Law Efficiency, Exergy Change of a System, Exergy Transfer by work, heat, and mass, Exergy Destruction, Exergy Balance: Closed System, Exergy Balance: Control Volume	8	Assigned during lectures.
COMPREHENSIVE FINAL EXAM			

COMMUNICATION PLATFORM:

Canvas will be used as our communication platform. I will be posting my lecture slides routinely for each chapter. Every single WebEx session is important. Students are strongly advised to be highly proactive throughout the semester to stay with the pace of online offering. Make sure you have installed Canvas and WebEx in your computer and that you are fluent in using these software.

Contact NJIT First Service Desk if you need assistance. I cannot resolve these issues for you.

POSTING LECTURE SLIDES:

- All lecture slides will be routinely posted in Canvas throughout the semester. This will be done either through using "Files" in Canvas or through providing a link for the location of the file.
- Successful performance in the course requires that you thoroughly review these materials immediately after each lecture.
- This should be followed by any clarification/question that you may have.
- Such discussions will be carried out by using the "Discussions" forum in Canvas.
- This approach will give exposure to others as well who may have similar questions.

COURSE GRADING SCHEME:

The course evaluation will be based on the following scheme.

- Quizzes
- 3 Mid-Term Exams
- Comprehensive Final Exam
- Attendance and Class Participation

Your course grade will be determined as follows:

Quizzes	10%
Exam 1	20%
Exam 2	20%
Exam 3	20%
Final Exam	25%
Attendance & Participation	5%

NOTE: The above is a tentative grading scheme. It is subject to slight modification if felt necessary by the instructor.

To be properly prepared for exams, you should read the textbook, review your class notes on a regular basis, and do the exercises problems suggested by the instructor.

Absolutely no make-up exams will be given. Do not ask for it.
If you miss an exam your marks for the exam will be zero.

TENTATIVE GRADING SCALE:

Letter Grade	Total Weighted Mark
A :	90 – 100
B+ :	80 – 89
B :	75 – 79
C+ :	70 – 74
C :	60 – 69
D :	50 – 59
F :	0 – 49

EXERCISE PROBLEMS:

Exercise problems will be assigned throughout the semester at the end of each topic/chapter. Students are strongly advised to do the exercise problems on time . This course has a heavy focus on conceptual understanding of the basics of thermodynamics. Doing the exercise problems will be very helpful to the students in clearly understanding the concepts. Students are highly encouraged to see the instructor to discuss any conceptual issue that may arise while doing the assigned problems.

OFF-LECTURE HELP:

There is no scheduled office hours due to COVID-19 pandemic situation. We will communicate through Canvas / Announcement / Discussions / emails and importantly during weekly WebEx presentations.

Students are advised to post their questions in Canvas / Discussions. This allows everybody to see the questions and participate.

A portion of the participation mark (2 out of 5 marks) will be allocated to the use of the Canvas Discussions forum.